

Do not go where the path may lead,
go instead where there is no path
and blaze a trail.

Salton
Sea
↓

Palm Springs
↓

Pasadena
↓
Irvine
↓

Interstate 10
↓



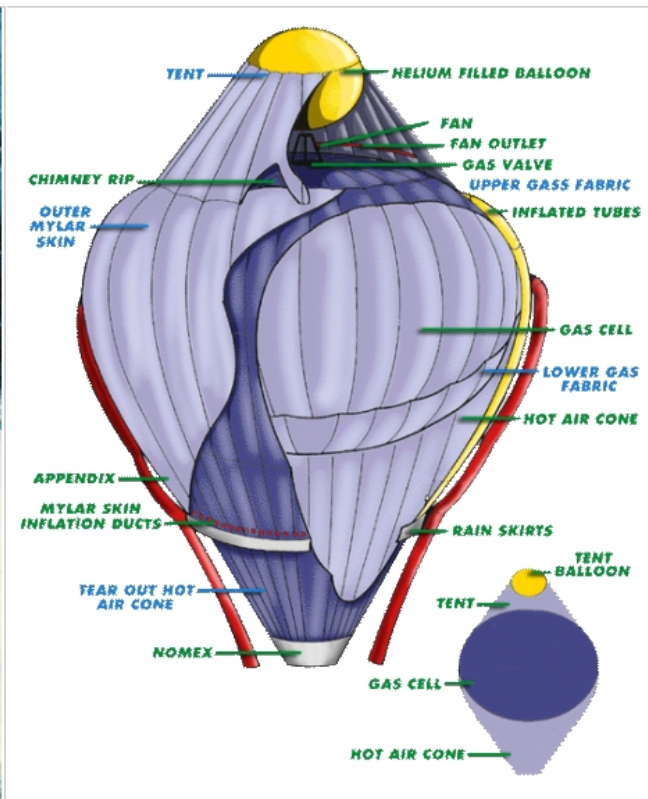
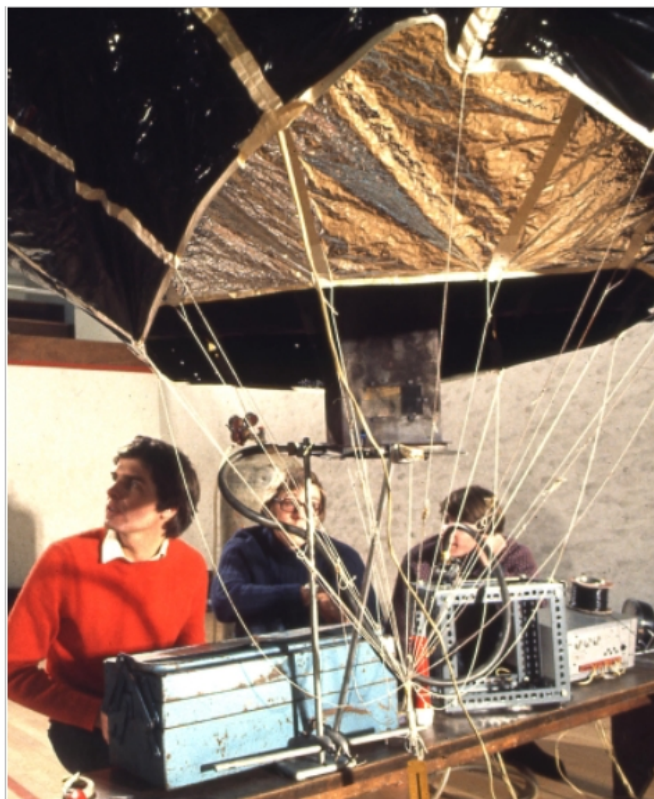


Fig 4 1974 double layer test 1981 double layer solar 1999 multi layer Breitling world flight

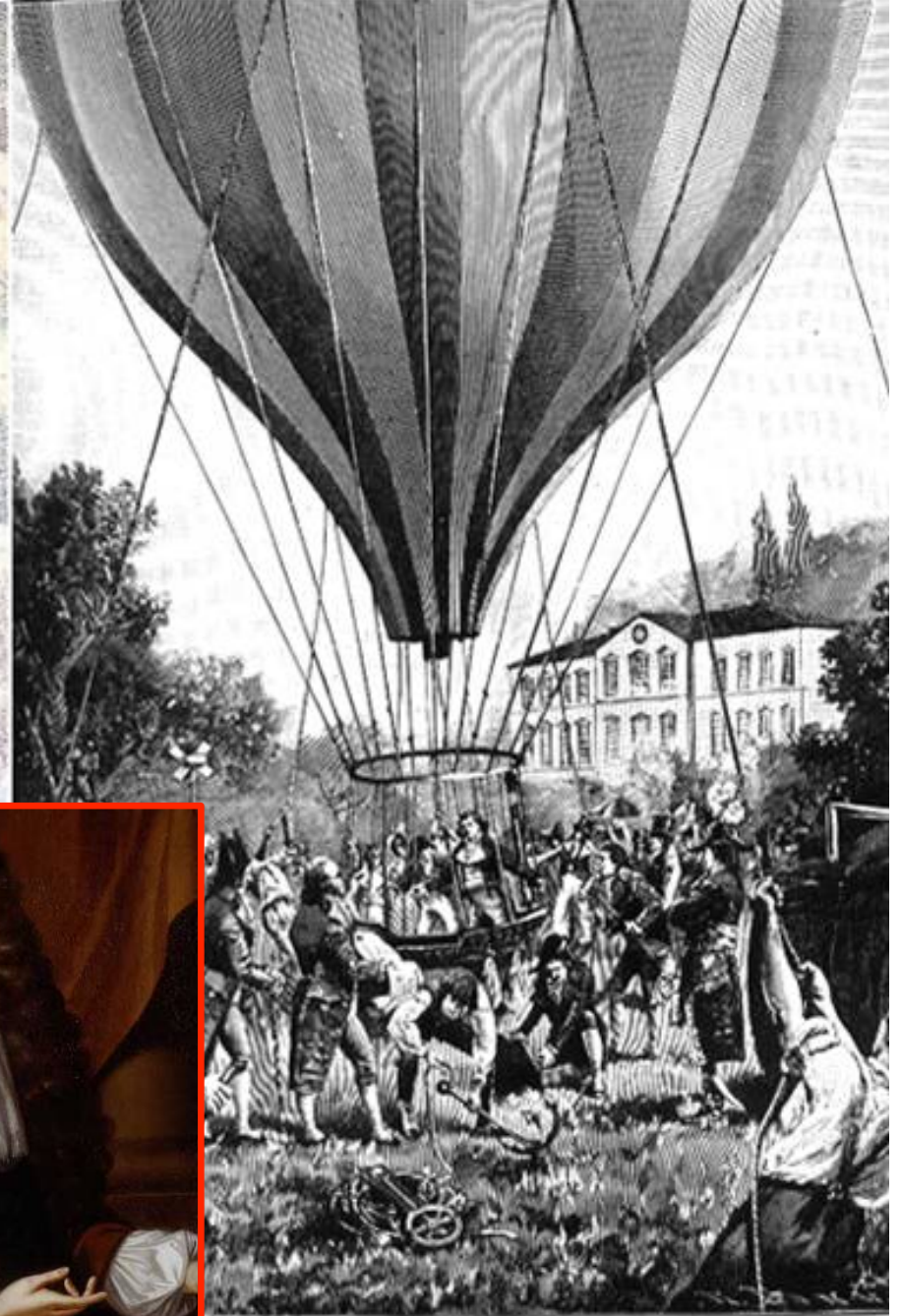
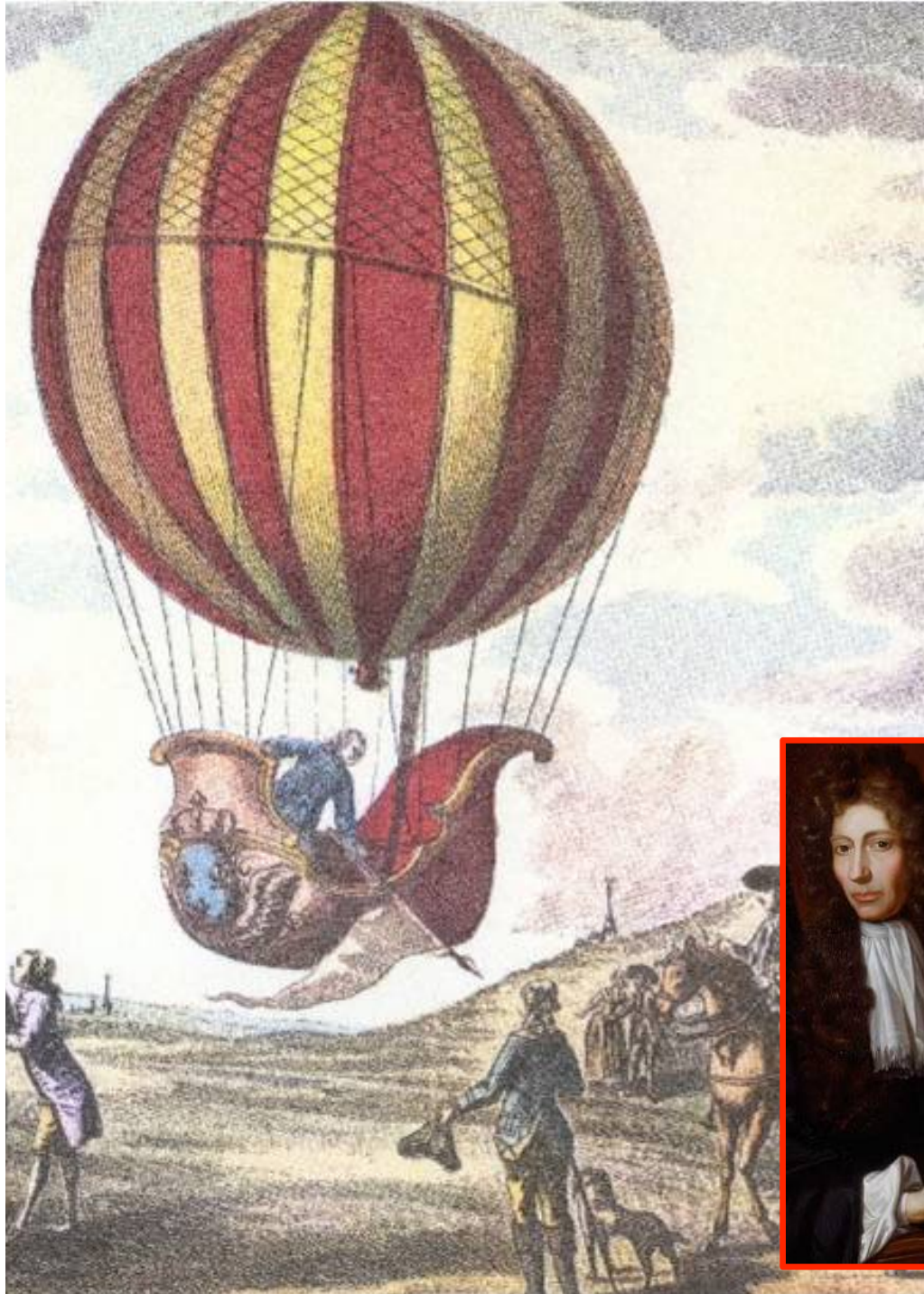
Parameters for a ten-layer Titan balloon and corresponding heat loss			
Altitude 10,000 m	Ambient 84 °K	Density 3.3 kg/m ³	6 m internal diameter
Outer fabric 17 gsm	9 inner layers 10 gsm	Conductivity ratio 2	7 m external diameter
Payload 100 kg	ASRG 22 kg	Envelope 12.3 kg	Lift temperature 139 °K
Heat Loss 210 Watts. An ASGR provides 360 Watts [thermal], a substantial surplus			

Industry consortium. Improved Titan design. Multi-layered: plenty of precedents.

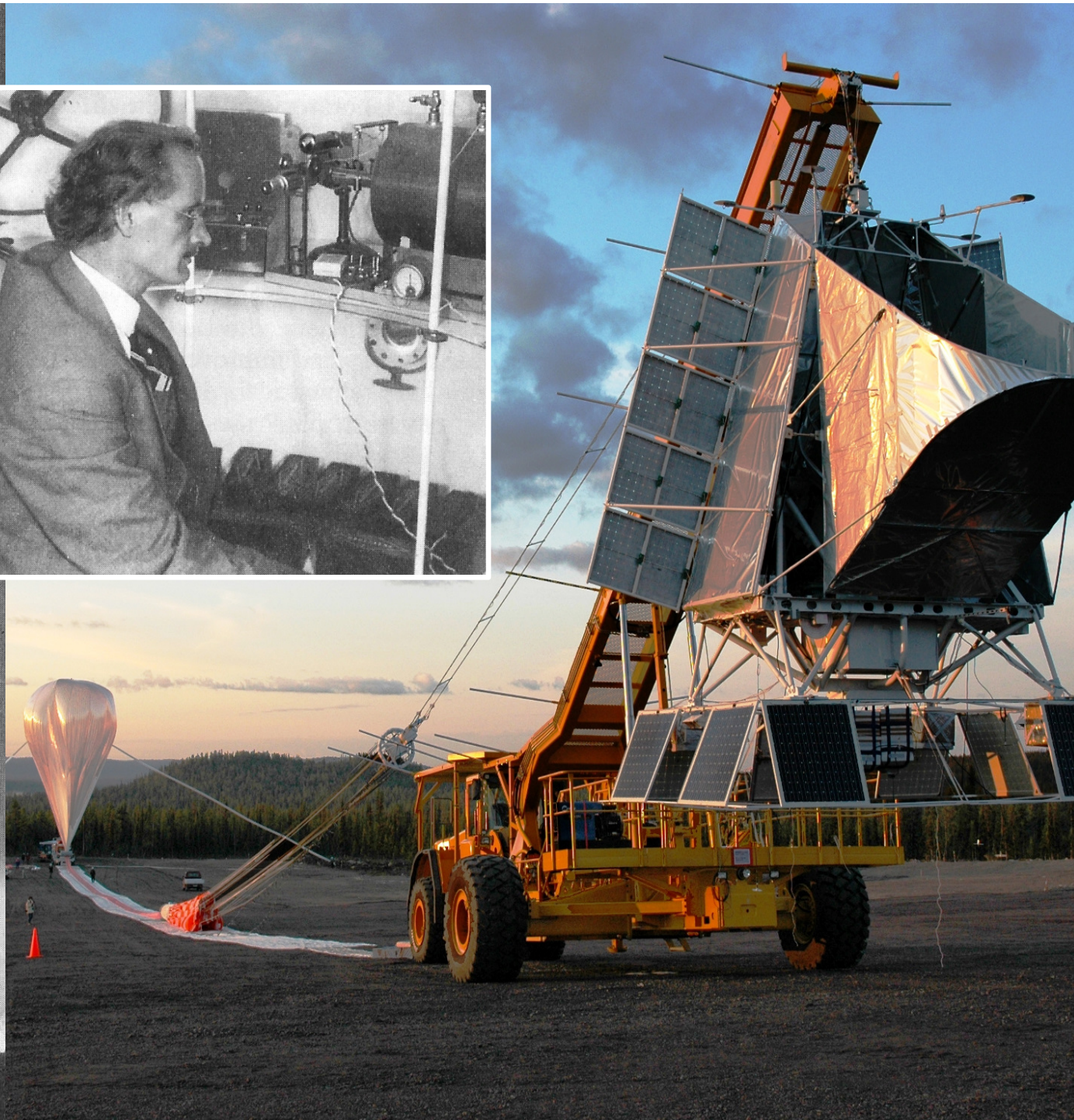
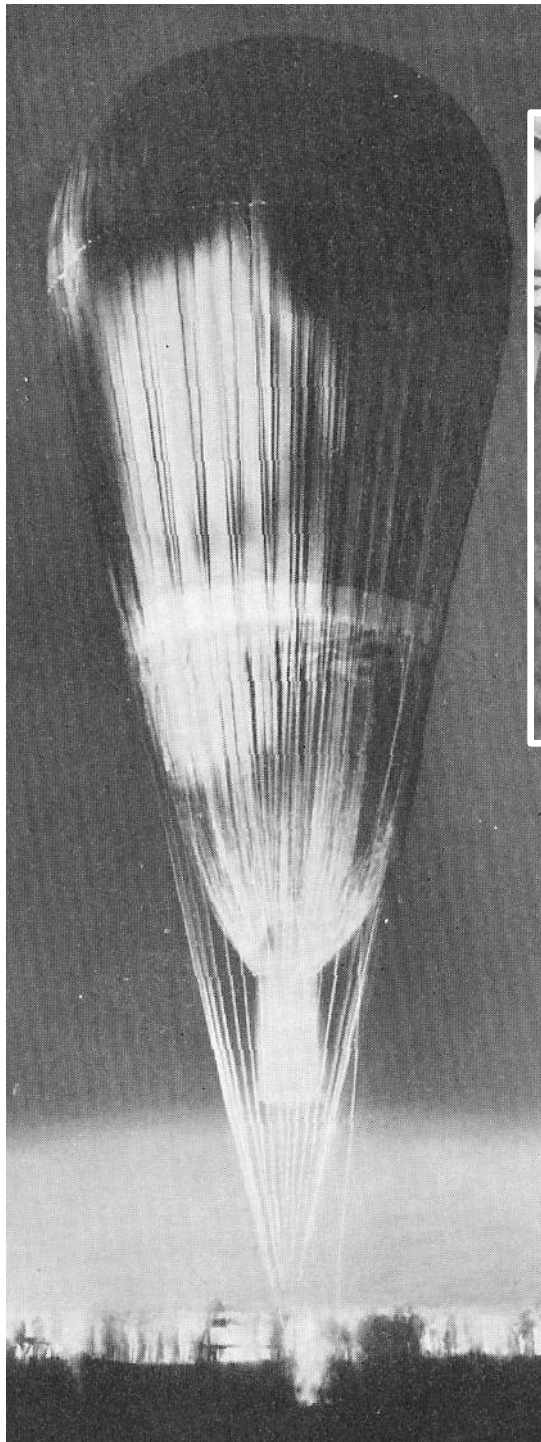
This is a work in progress.
But this is a workshop.
Full paper in September at AIAA.

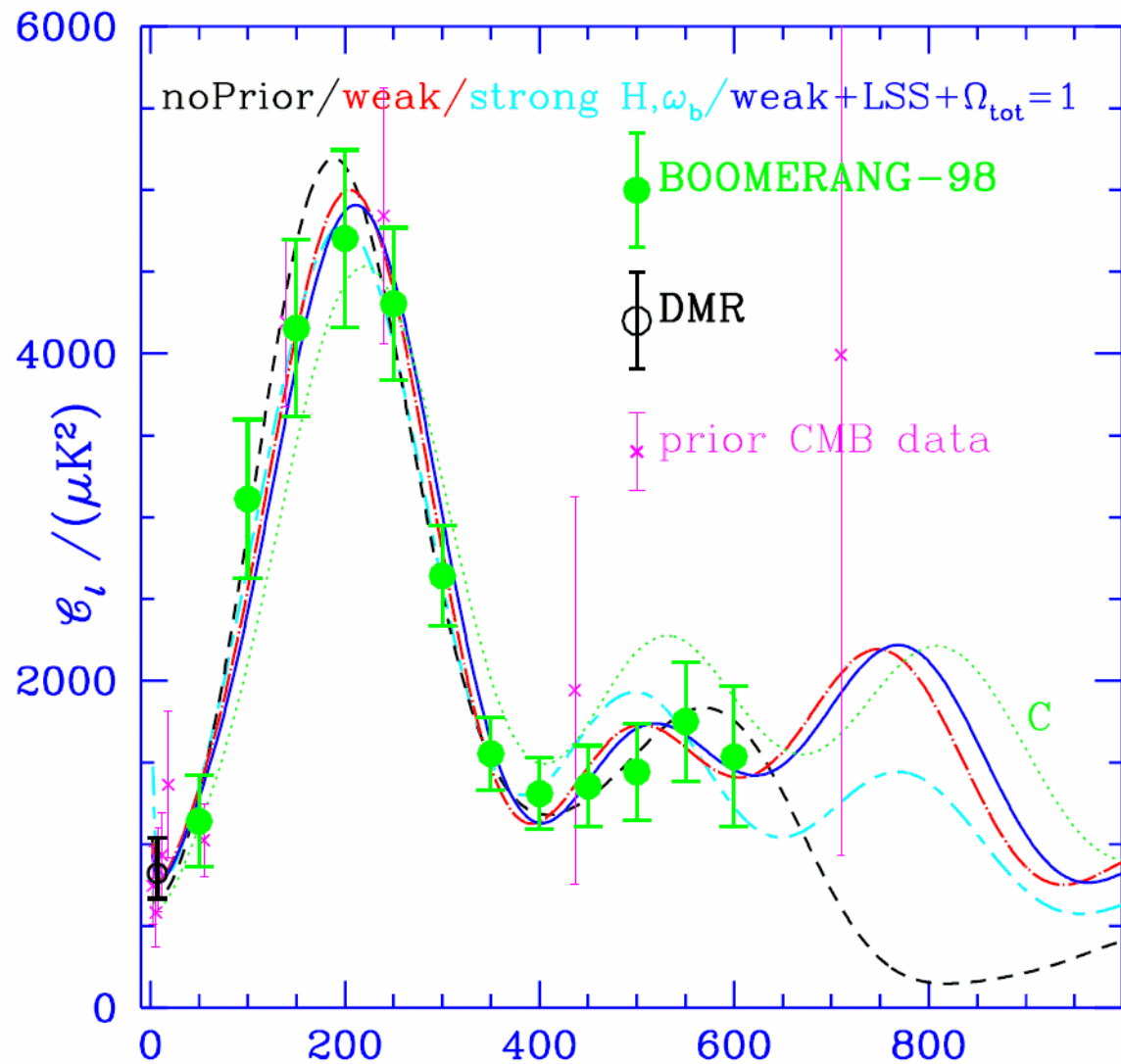
One ASRG. But Decadal recommends
even JEO should use ASRG.

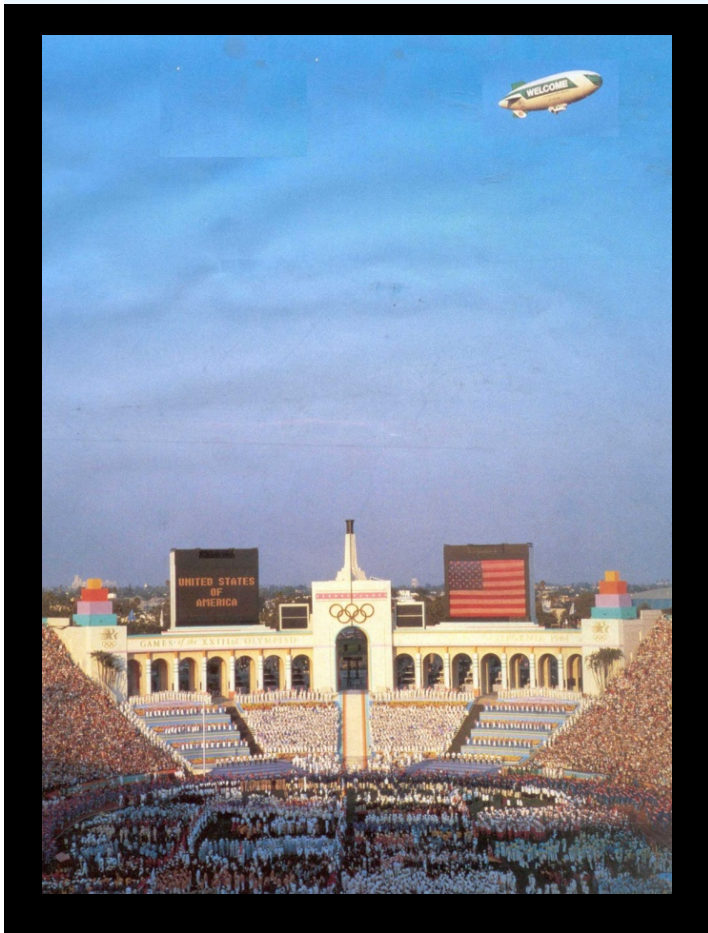
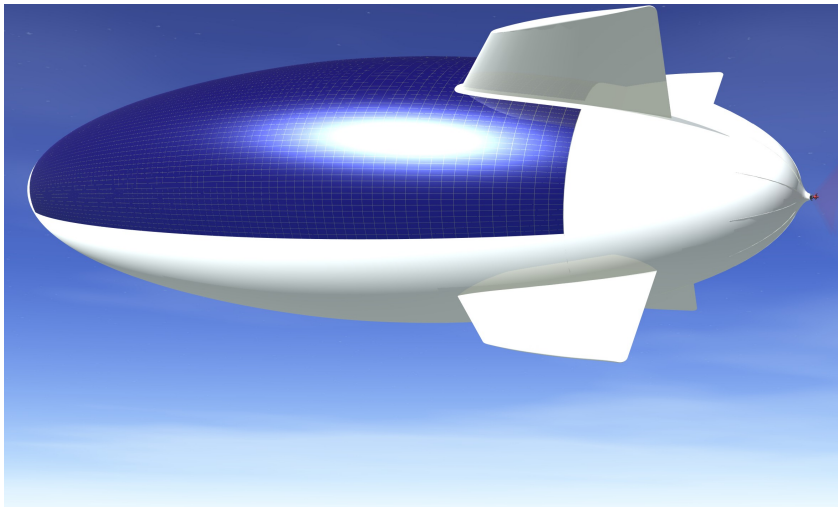
Design to be testable.



67. — Ascension de Gay-Lussac à Paris, le 16 septembre 1804.
19 "W film positif







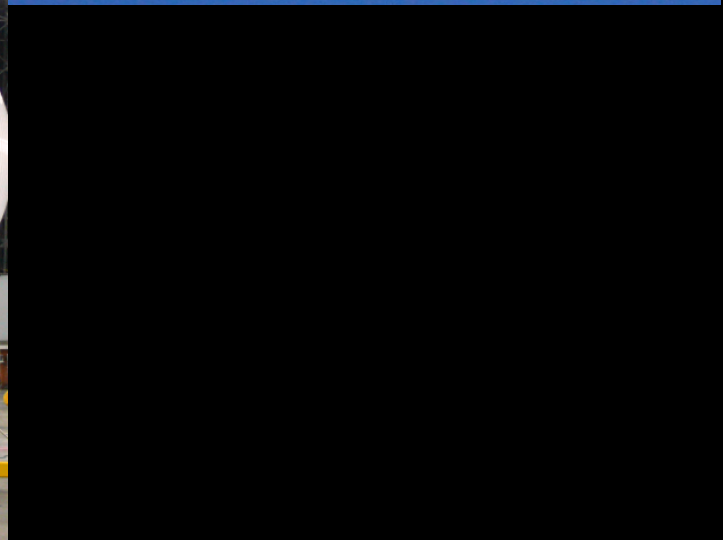
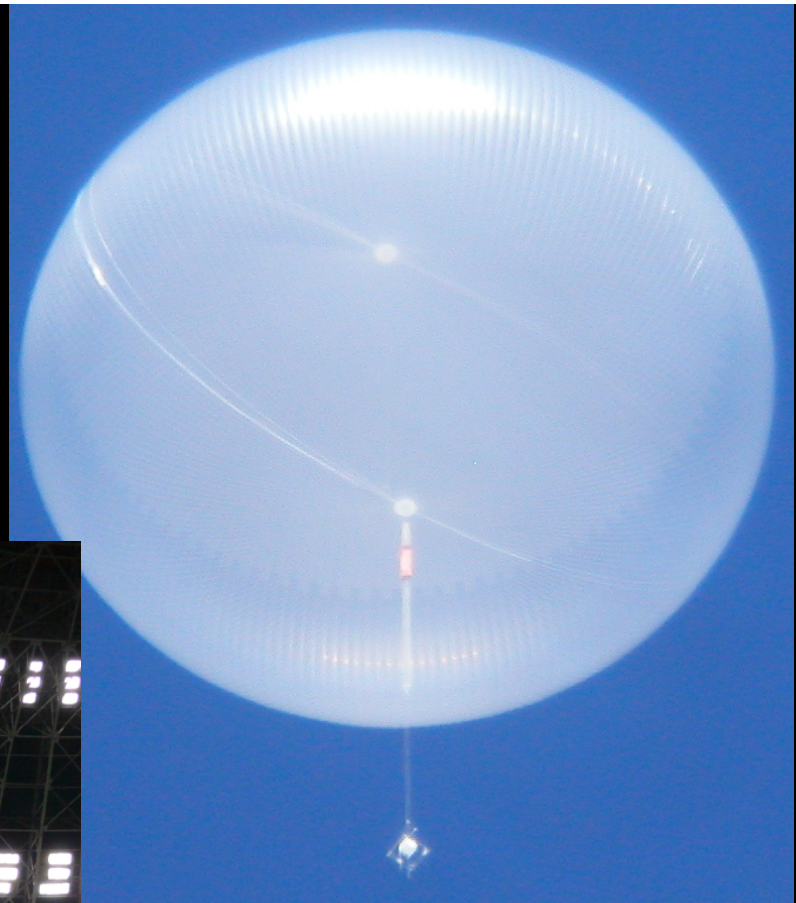
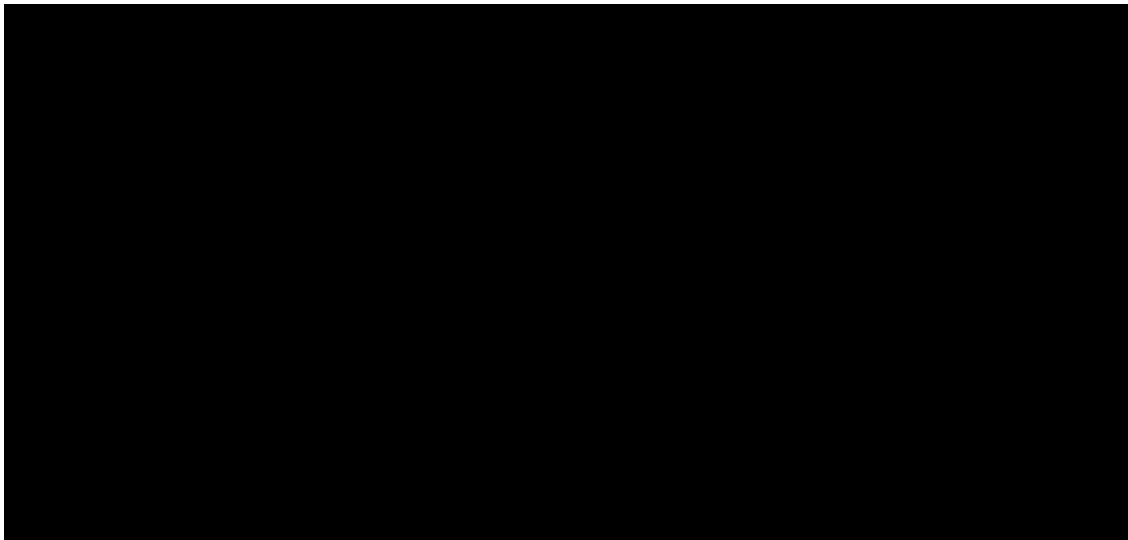




"A ship in harbor is safe, but that is
not what ships are built for."

John A. Shedd







Space scientists worry that balloons are novel and hence risky.

They should not be thought of as novel spacecraft, but balloons that simply arrive via space.

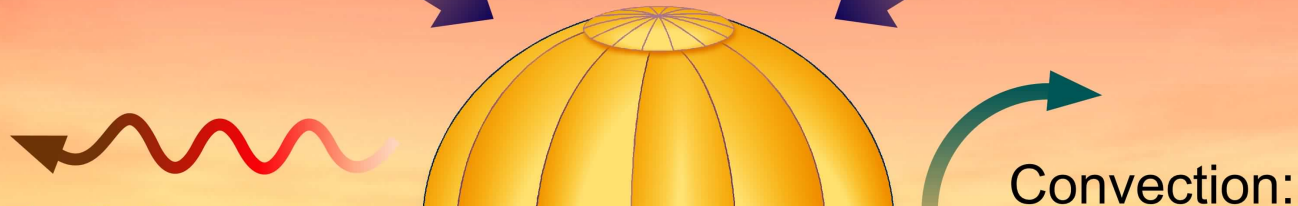
Balloons are extremely familiar. 50 million weather balloons. At least 4 million hot air balloon flights. Tens of thousands of flights by hydrogen and helium balloons.

Conditions at potential Solar System destinations are well within terrestrial experience.

Titan's conditions are highly favorable and familiar for balloons.

SOLAR HEAT 1,000
TIMES LESS

ULTRAVIOLET > 1,000
TIMES LESS



**Titan conditions are a 1,000 times better
for balloons than Earth conditions.**

Fabric coating very
cold: diffusion many
orders of magnitude
less.



15 times greater for a
given temperature rise.

VERY LOW TEMPERATURE
VERY HIGH DENSITY
LOW GRAVITY

But perfect for balloons which go anywhere!

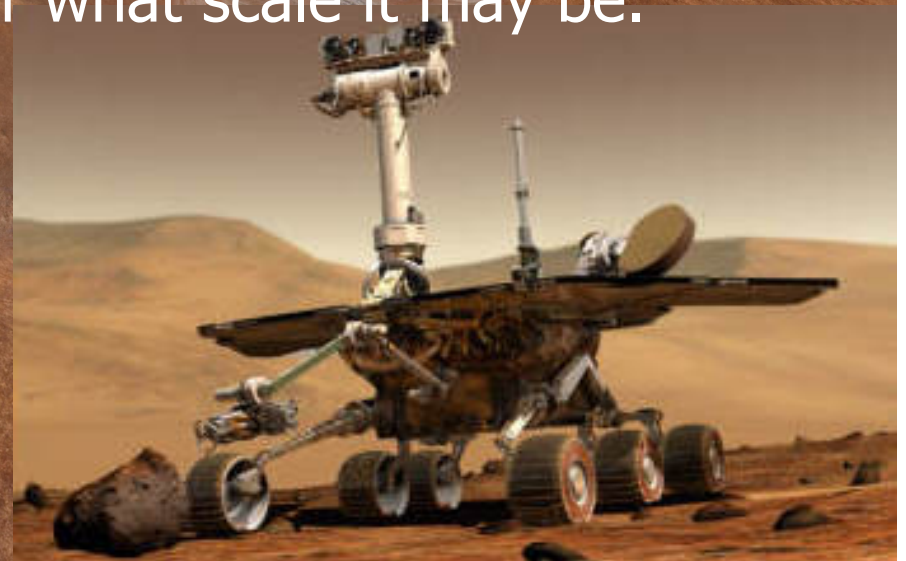
Balloon is shown crossing the shore, potentially a very interesting region but impossible for Rovers.

It can fly from a meter to ten kilometers above the surface. Unlike a Rover, it is never left wondering what is behind the hills.

"The Black Cloud problem." Change altitude to see "weird life" no matter what scale it may be.

Artist conception of scientifically fascinating Hotei Arcus.

No place for wheels:



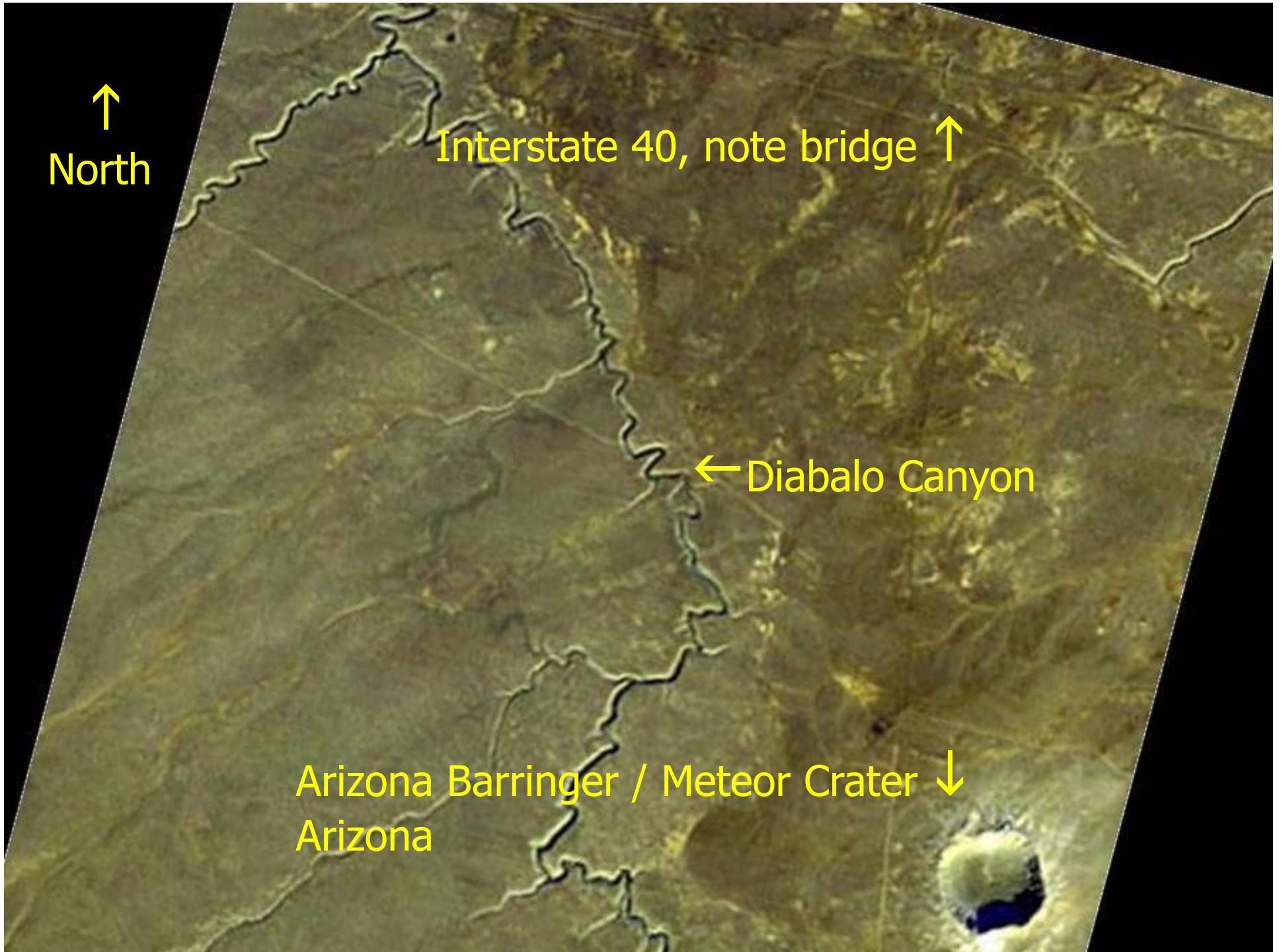
M. Carroll

↑
North

Interstate 40, note bridge ↑

← Diabalo Canyon

Arizona Barringer / Meteor Crater ↓
Arizona





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A yellow and orange hot air balloon with black geometric patterns is floating in the air. The balloon is positioned in the center-right of the frame. The background shows a vast desert canyon with steep, eroded walls and a flat floor. The sky is blue with some light clouds. The lighting suggests it's either early morning or late afternoon, with long shadows cast across the canyon floor.

This is "Contour Flying",
very popular with pilots.

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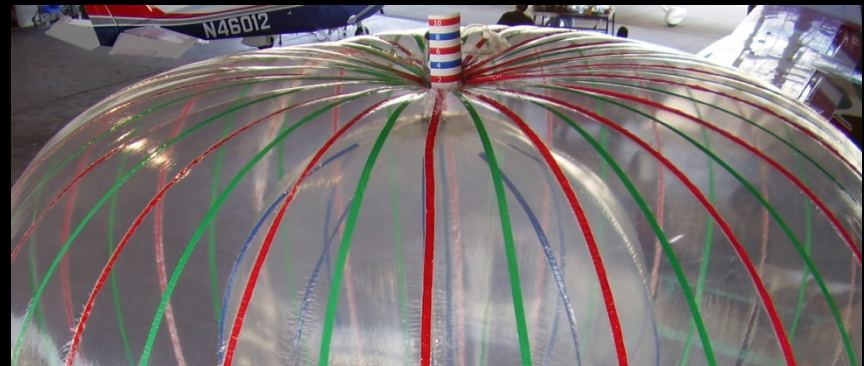
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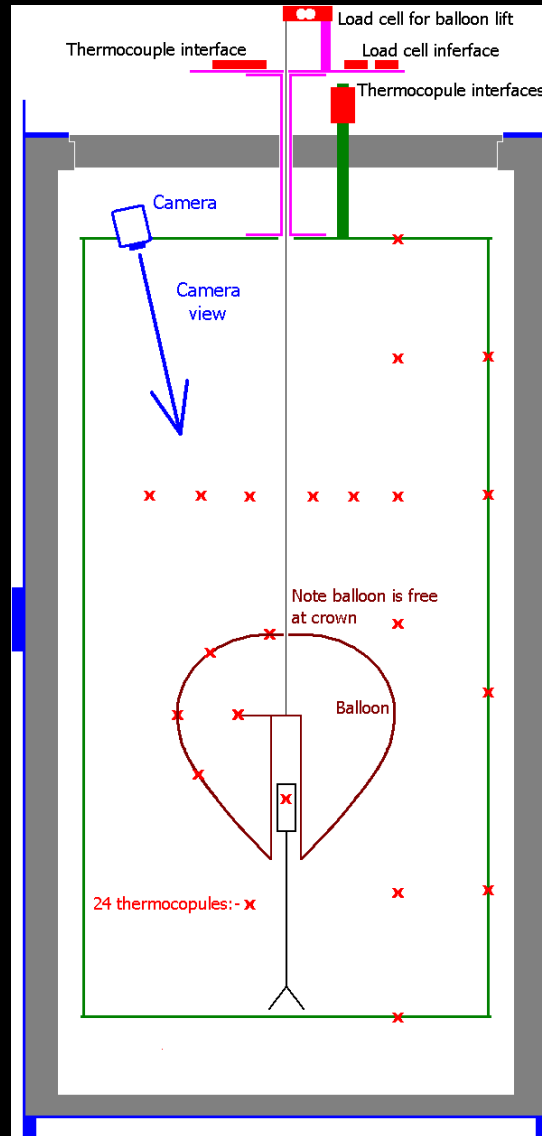


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Within the limits of the experiment, the qualitative behavior is the same from this tiny balloon at cryogenic temperatures to a balloon 70,000 times larger.

Computational Fluid
Dynamics [CFD] modeling
of Titan balloon convection
by Professor Tim Colonius,
Caltech.

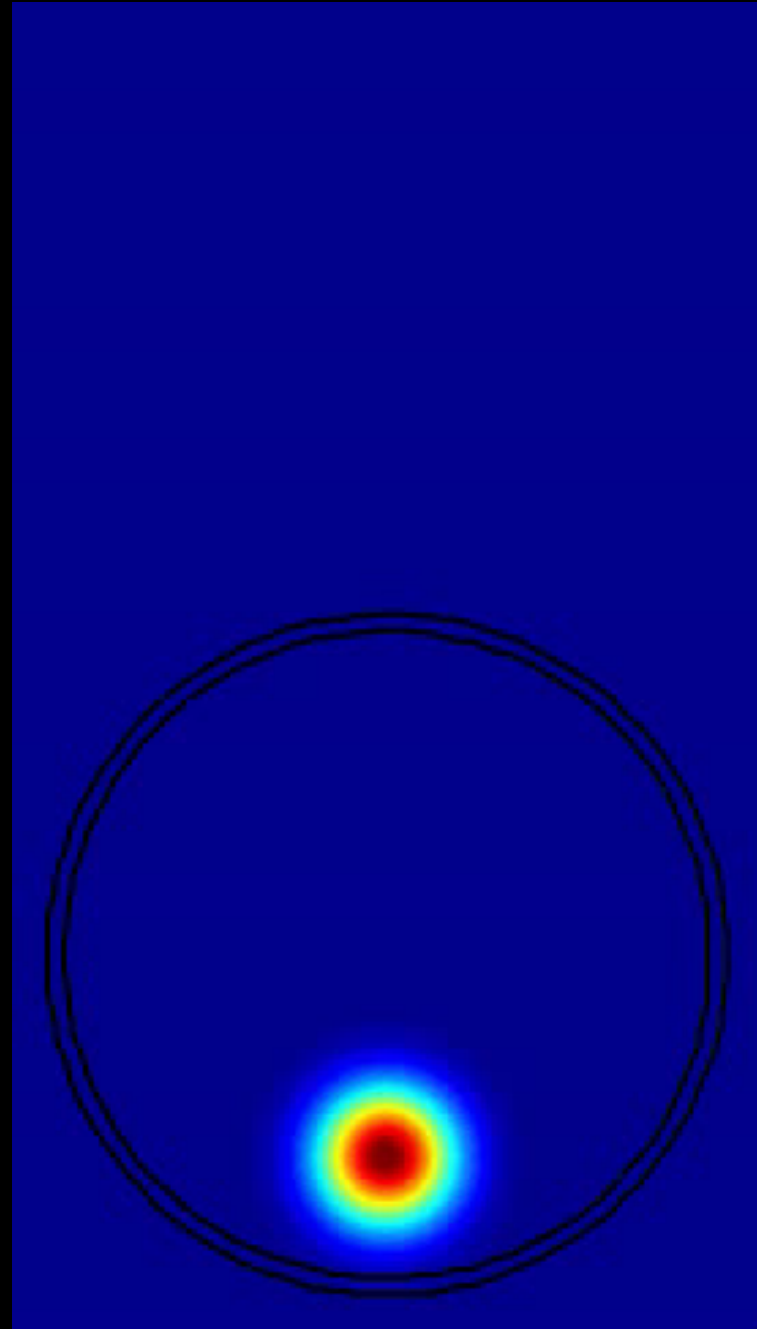




Photo set courtesy
Rekwin Archive

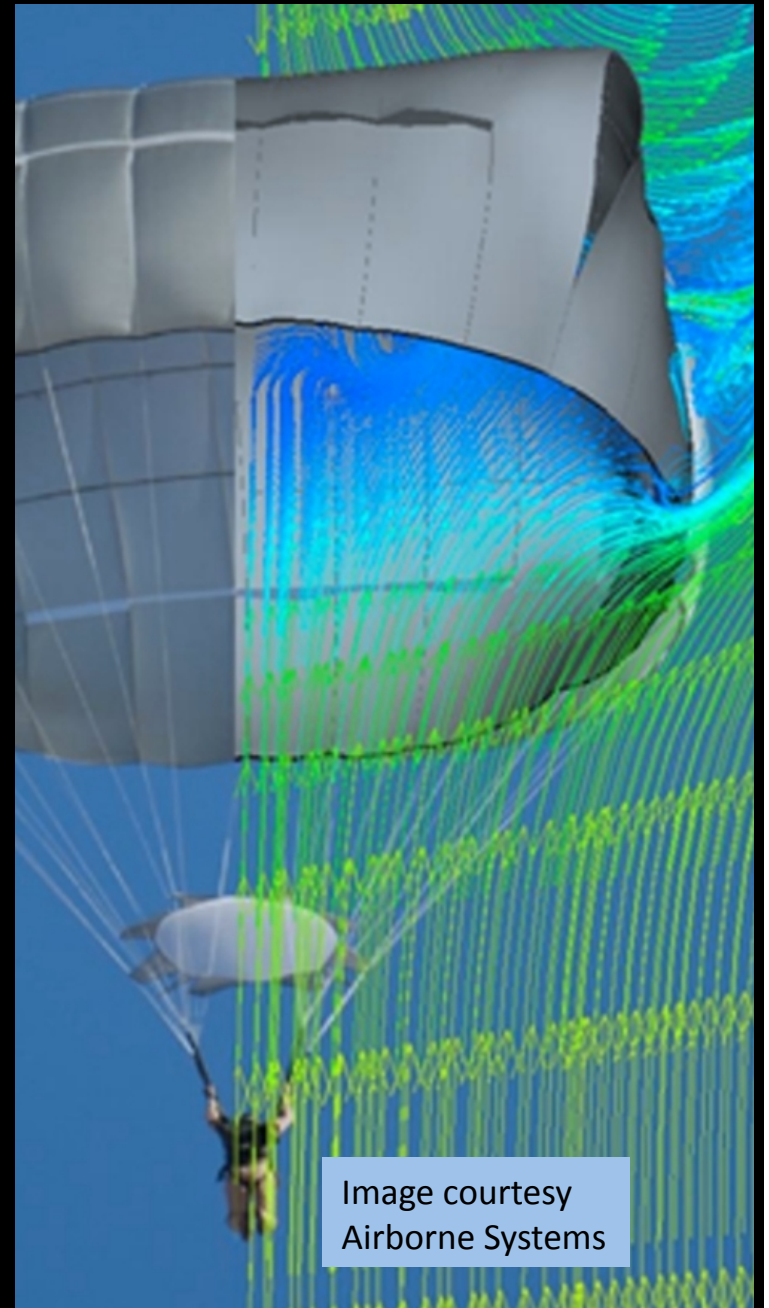
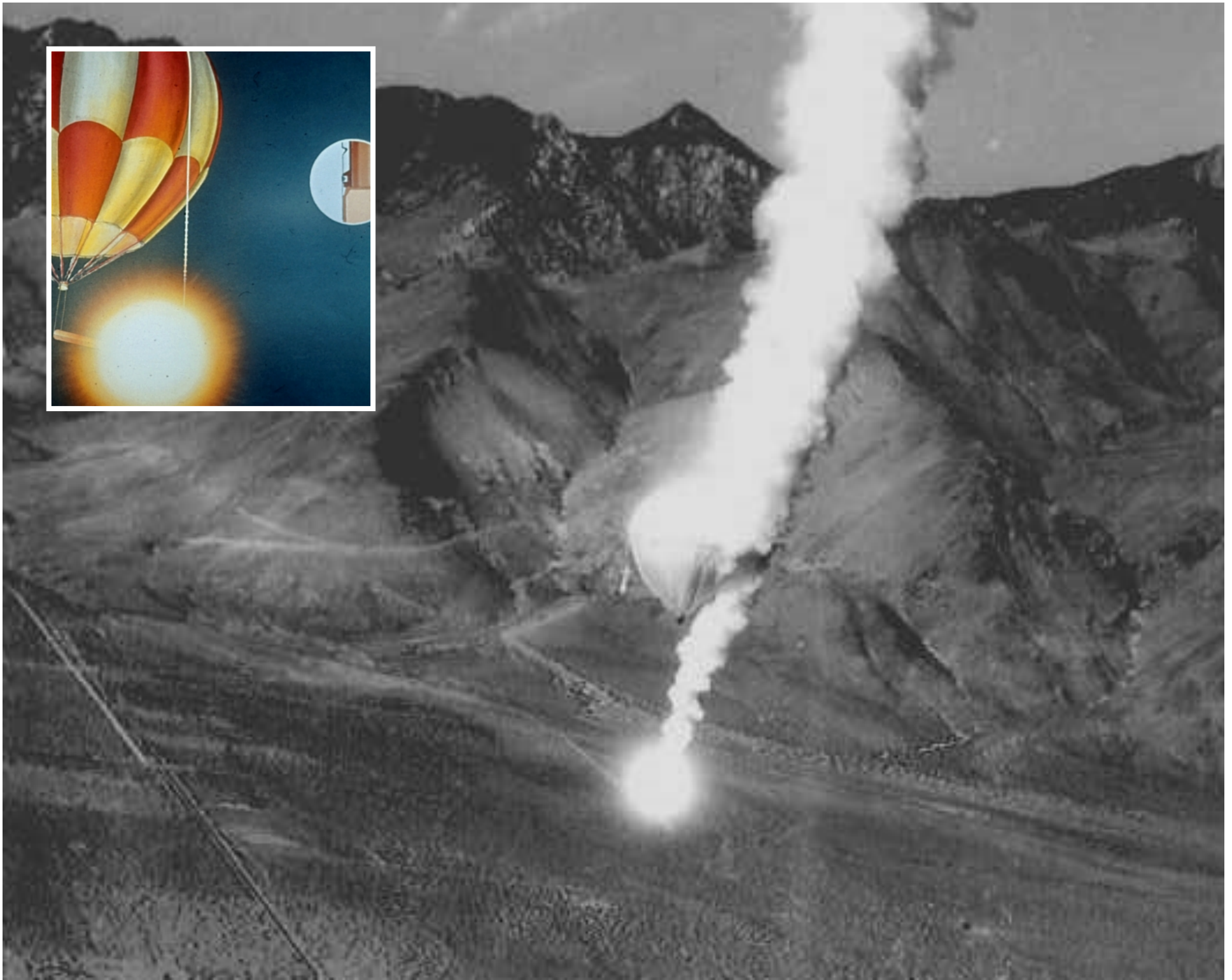
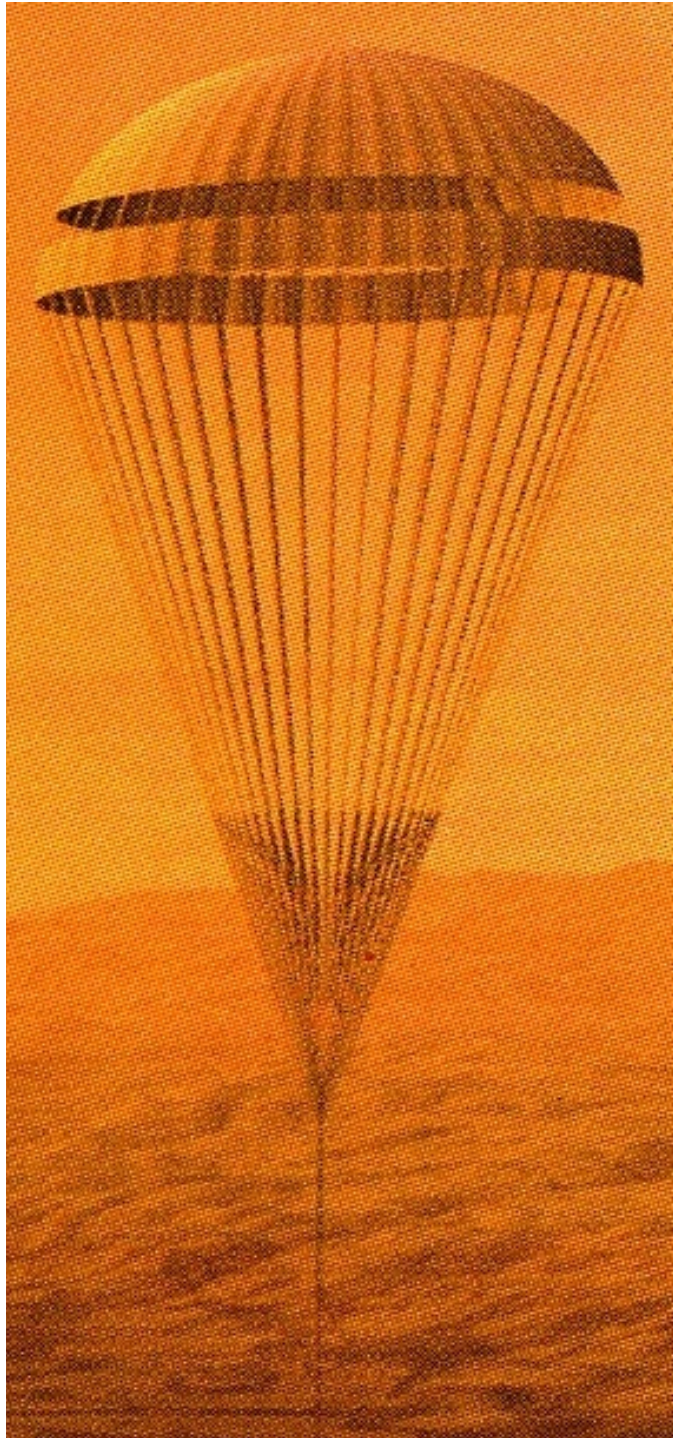


Image courtesy
Airborne Systems





Rob Sinclair
Chief Engineer,
Airborne Systems Space Group

Former test jumper
Designed Huygens Parachute
Design of CEV Parachute

The Source for FSI

FSI = Fluid, Structure Interaction

WEATHER CONDITIONS

With any aircraft design and especially lighter than air craft, the first thing you ask is what are the weather conditions?

"Sail on the Central Park reservoir or around Cape Horn?"

Can't decide most basic things, even fabric strength.

Start at the safest zone for the season.

Steering objectives.

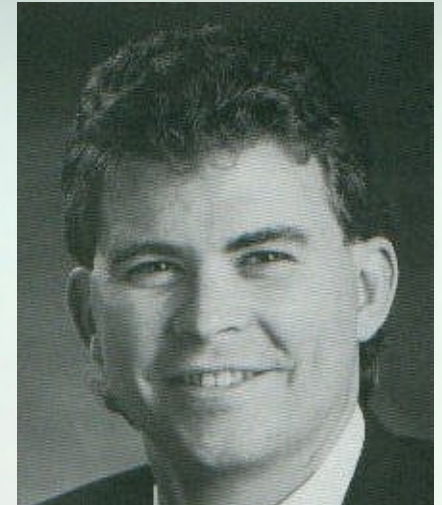
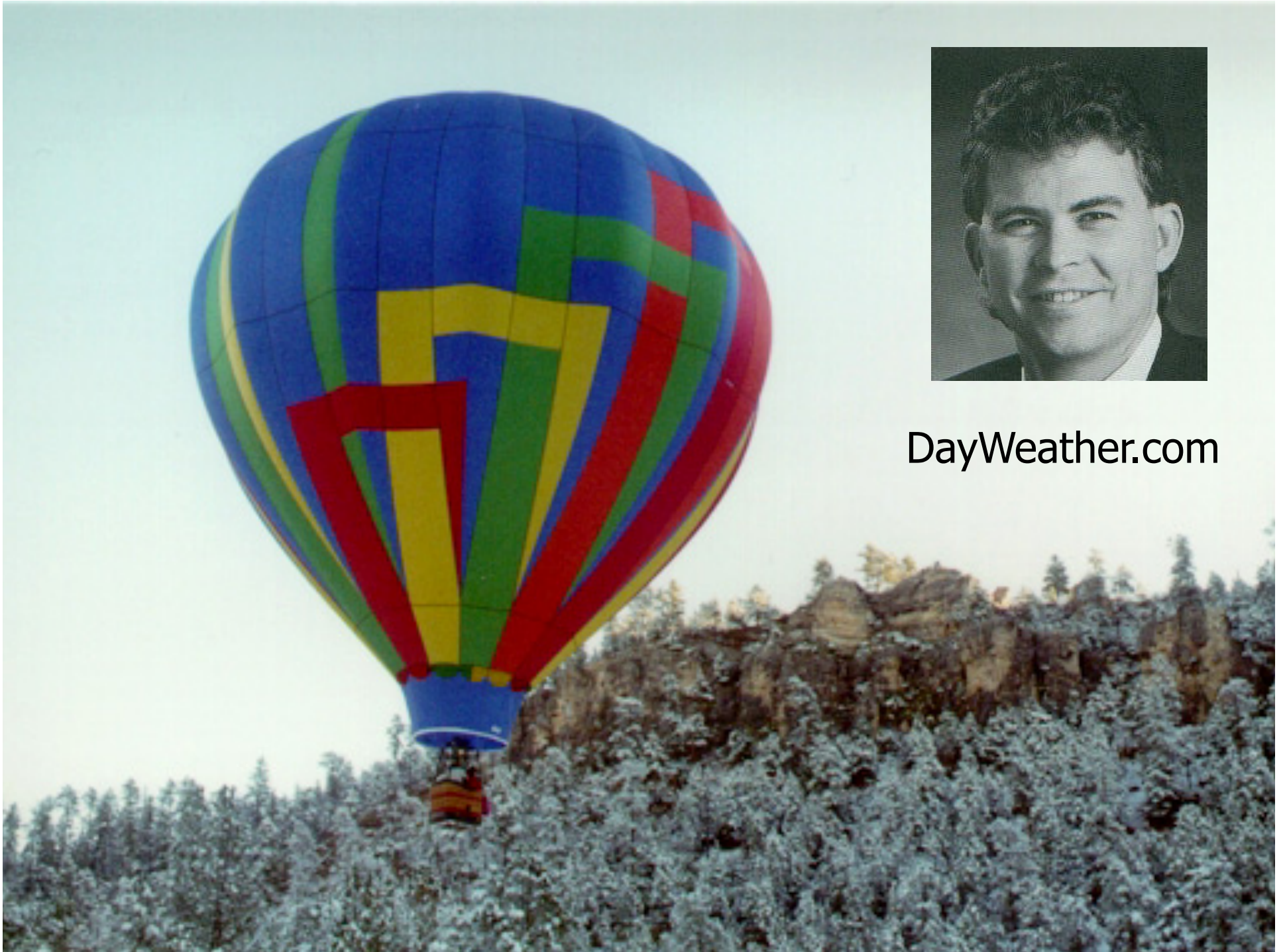
Local and/or short-term phenomena especially convective clouds.

Atmosphere temperature variation of short time and distance.

Lapse rates.

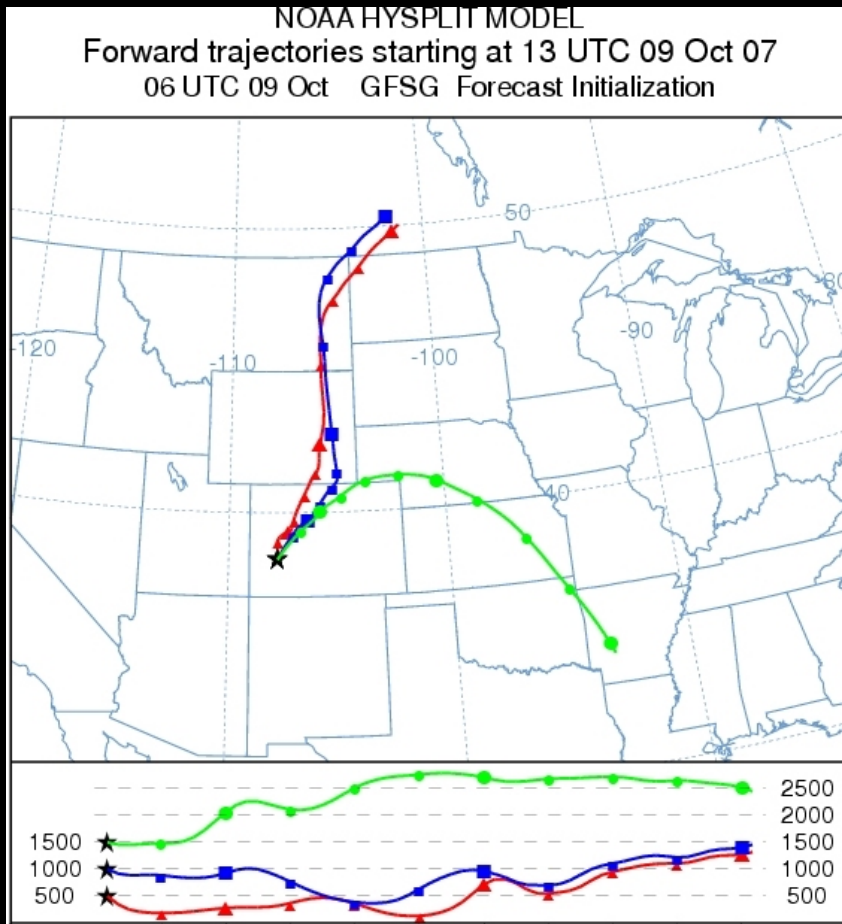
STRATEGY FOR DEALING WITH UNCERTAINTY – CRUCIAL IN MANNED FLIGHTS

State of the art ... which is evolving



DayWeather.com

STEERING



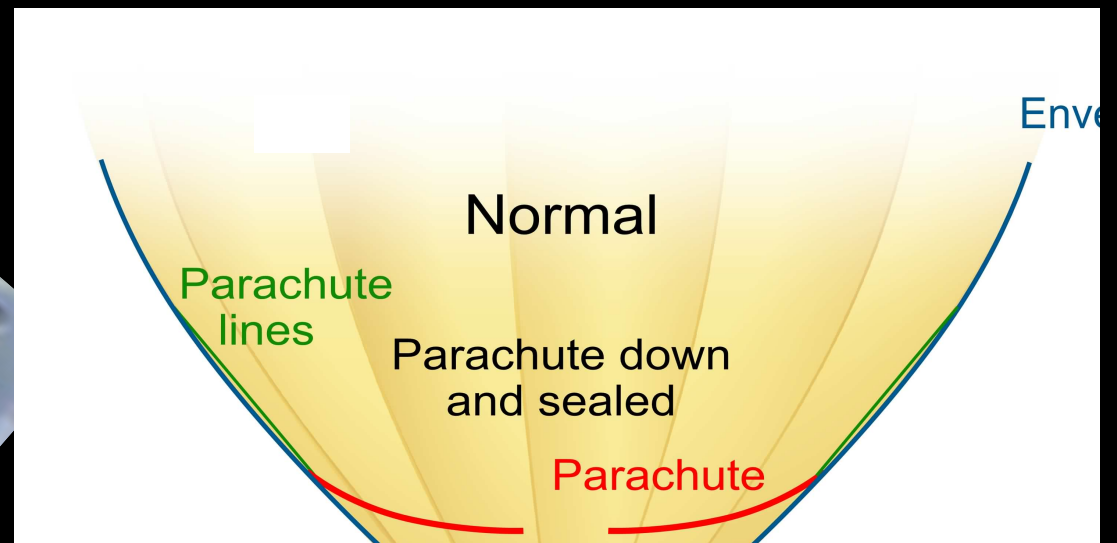
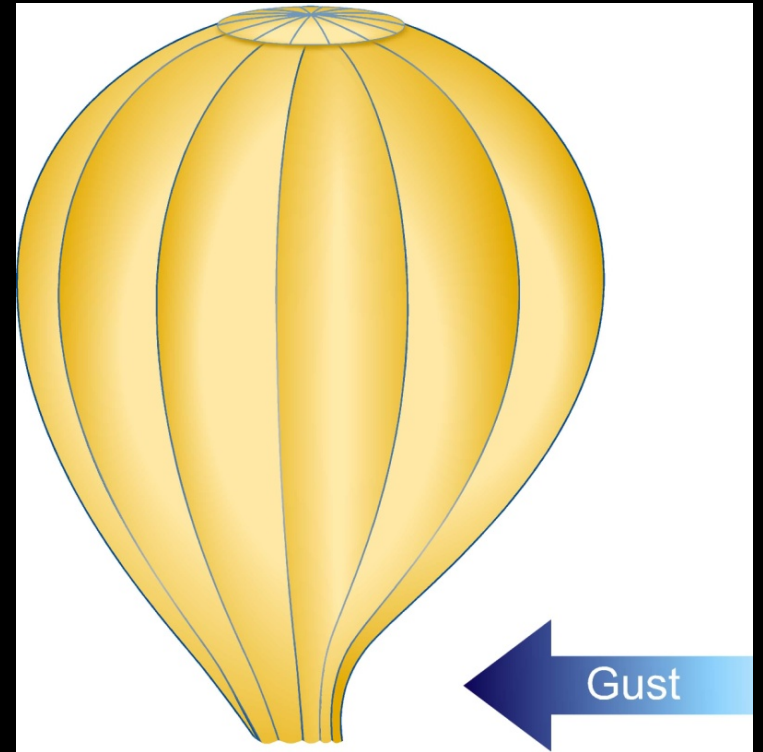
Continental to global scale
steering with wind models.

Propellers a minor penalty
and a major benefit



"Autonomous" steering over 10
kilometers

Source: Julian Nott / www.NOTT.com

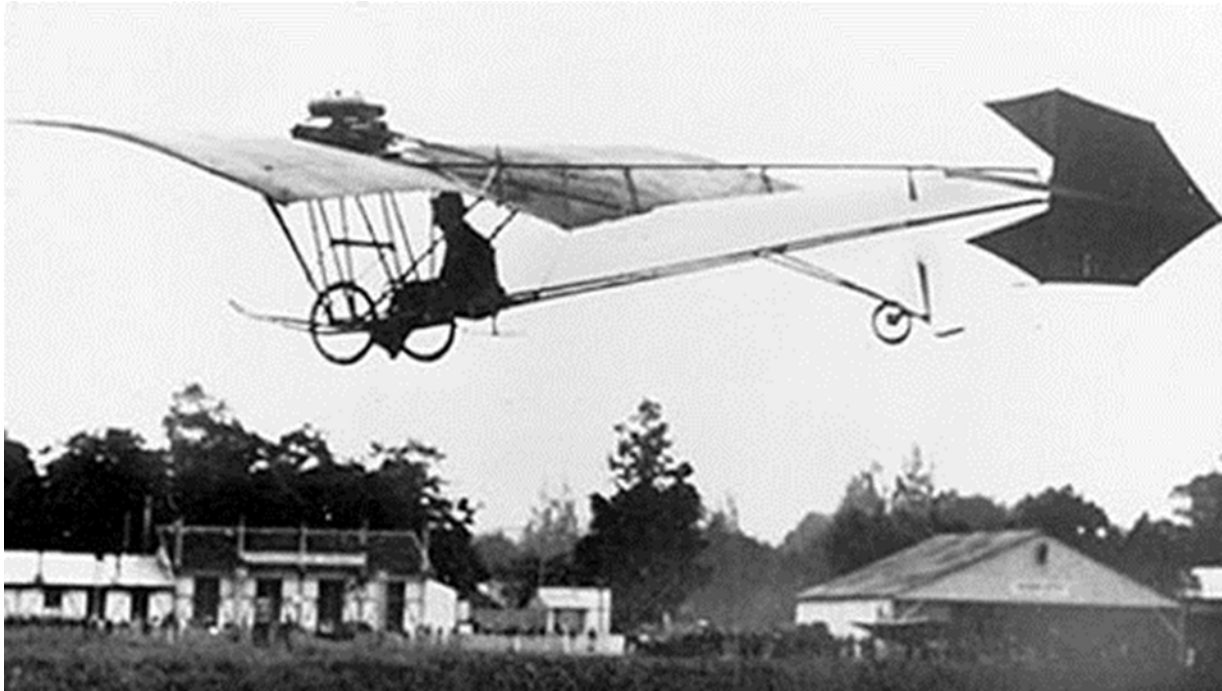




1903

1908: Just
5 years.





1908



2008 - full
100 years

ge.o.graphy
ocean.o.graphy
titan.o.graphy

titanography.com
up by July 4 Weekend

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